HCAL Calibration with Collisions Data Workflow

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HCAL Calibration with Collisions Data

Using a sequence of calibration steps:

- Equalize the response of HCAL in phi for each iEta ring (towers with iEta=const) when possible
- Equalize response across iEta in HB and part of HE for fixed energy
  - Set a scale corresponding to $E_{had}^{cl}/p_{trk} = 1$, where
    - Track: hadron, p_{trk}=50 GeV, MIP signature
    - $E_{had}^{cl} = \sum E_i(twr)$
- Provide a smooth (as much as possible) response function across eta of the detector

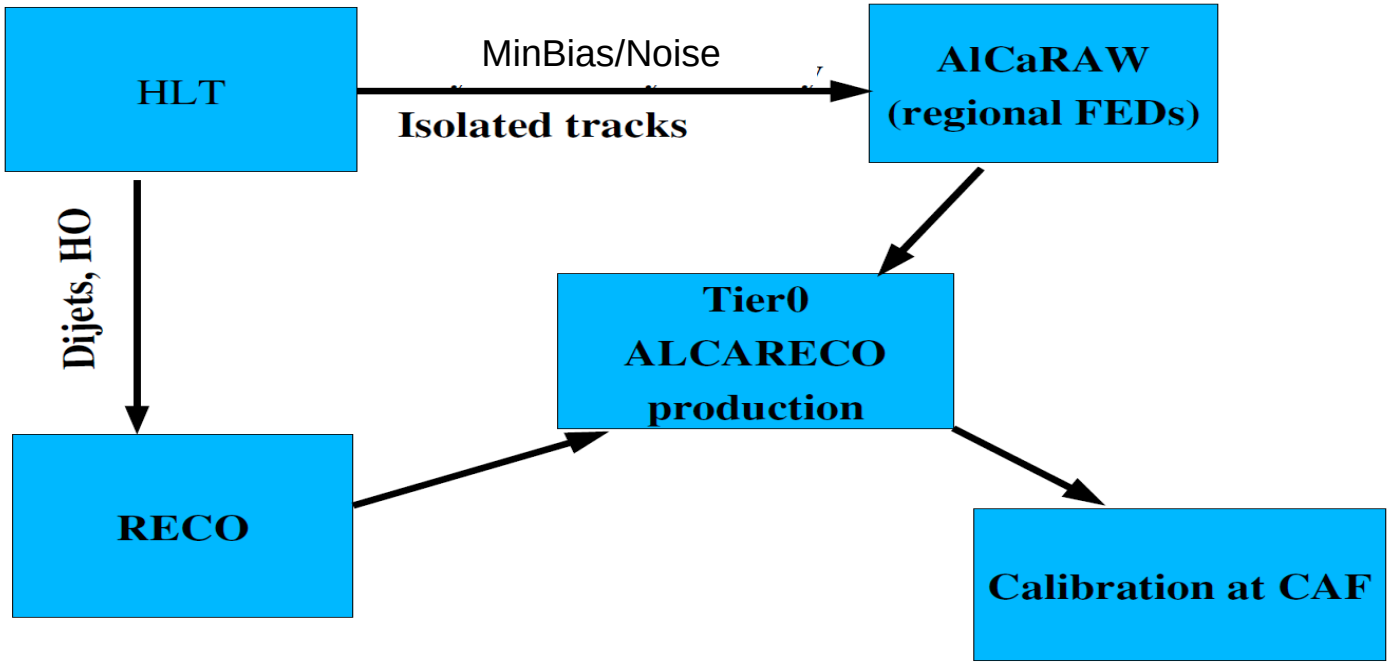
Requirements for the calibration

- The HCAL calibrations can not ensure:
  - Equal response for all energies,
  - Not even "flat response" for all energies
- However, the corrections should be:
  - Reproducible
  - Possible to obtained with reasonable amount of data (starting with ~1 week)
    - Use physics objects that can be efficiently triggered on
    - Fit within allocated trigger rates.

Samples for HCAL calibration with early data

- **Isolated tracks**:
  - The main source for the calibrations (reference calibration point defined with respect to tracks)
  - Selected with a dedicated trigger:
- **MinBias events and Noise samples** with no zero suppression (NZS)
  - Data collected in special NZS runs
  - MinBias: dedicated HLT
  - "Noise" sample: MinBias from the time slices in front of the readout window
- **DiJet samples**:
  - Selected with the single jet triggers:
    - Jet50: calibration
    - Jet20, 30: validation

Getting the calibration samples



• The AlcaReco output files contain all information to perform calibration of a certain type.
• Once the AlcaReco files are produced and moved to CAF, the HCAL DPG has the “operational” responsibilities

Responsibilities for Getting AlcaReco Data

- Development and optimization of the dedicated HLT triggers:
  - Select calibration objects to be sent in AlcaRaw Format
- Development of AlcaReco Producers for the different streams:
  - Produce AlcaReco output at Tier0

(see Grigory Safronov's presentation on triggers and streams)

The version/content of the Producers is tied to the SW release used in data taking/processing

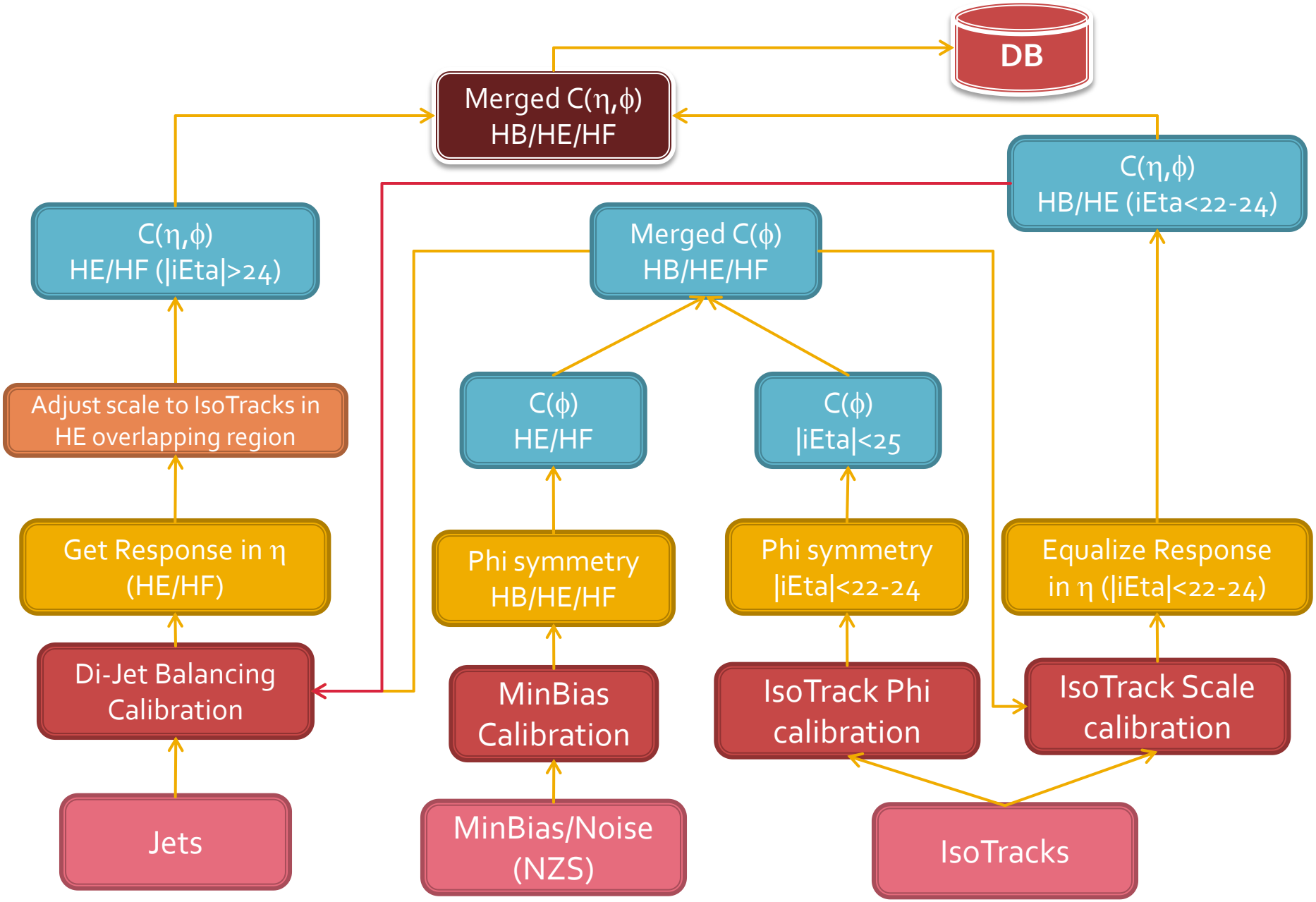
Time sequence of calibration steps

The sequence is determined by the prerequisites for each calibration step

1. Intercalibration in phi using isolated tracks and MinBias/Noise events when possible (presentation by Olga K.)
2. Energy scale corrections
   - from isolated tracks in HB and part of HE
   - from DiJet E_T balancing in HF and part of HE

   (presentation by Andrey K.)

- After each calibration step a validation will be performed to ensure that the correction constants perform as expected


DB
Merged C(η,ϕ) HB/HE/HF
C(η,ϕ) HB/HE (iEta<22-24)
C(η,ϕ) HE/HF (|iEta|>24)
Merged C(ϕ) HB/HE/HF
Adjust scale to IsoTracks in HE overlapping region
C(ϕ) HE/HF
C(ϕ) |iEta|<25
Get Response in η (HE/HF)
Phi symmetry HB/HE/HF
Phi symmetry |iEta|<22-24
Equalize Response in η (|iEta|<22-24)
Di-Jet Balancing Calibration
MinBias Calibration
IsoTrack Phi calibration
IsoTrack Scale calibration
Jets
MinBias/Noise (NZS)
IsoTracks

Remarks

- Due to limited tracker coverage have to use jets in part of HE and in HF for setting the scale:
  - Changes the nature of the calibration
  - Single particle response will depend on eta in this region
    - Jets are balanced based on E_T
    - Composed of many particles (compared to single isolated tracks)
- The corrections obtained from isolated tracks and di-jets overlap in a ~3-4 iEta rings

Workflow of AlcaReco data processing

- Analyzers select events of interest and store the information in compact ntuples: Run on CAF
- Calibrators take as input the ntuplized data and derive the correction factors
- The constants from different ranges are merged, and after validation, stored in the DB for data Reco

This scheme allows for parallelization of data processing

- Analyzers can process the data in ~several hours (even < 1h)
- Get corrections from the calibrators in ~5-10 min

This part of the workflow allows more flexibility: possible to add improvements, new features and algorithms as needed

Status

- All the code is functional in CMSSW 2_1_X, will migrate to 3_0_X
  - Tested on MC
  - New MinBias/Noise producer based on digis was tested on cosmics
- Further things to consider
  - Filters for bad/anomalous cells
    - Study the effect on calibrations and develop algorithms to handle such cases
  - Study the effect of pile up:
    - Impact on selection efficiency
    - How to handle introduced biases

What's next

- Presentations covering:
  - Factors impacting the calibration
  - Status of workflow steps/components
  - Issues and to-do lists
  - Impact of the calibrations
- Your input and suggestions